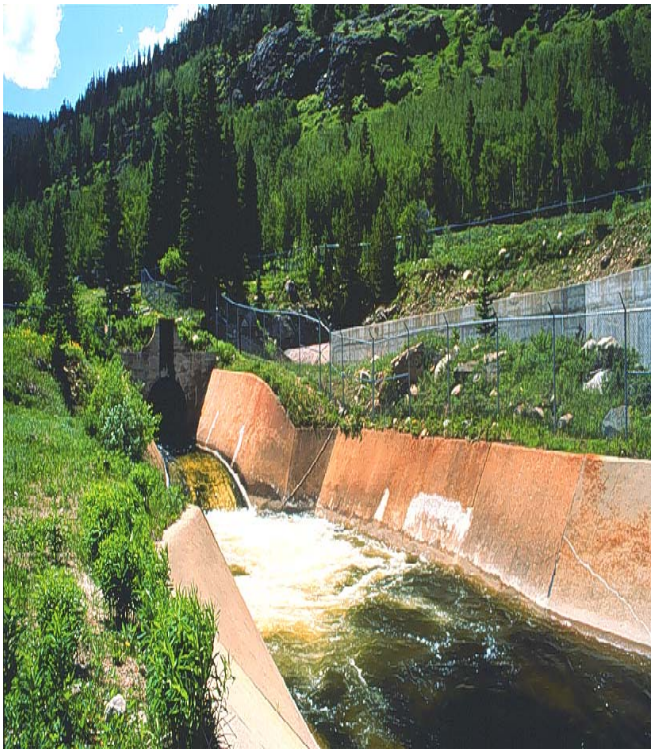
Moffat Collection System Project

Information Document

September, 2003

Metro Wastewater Treatment Plant Outfall ↓

East Portal Moffat Tunnel →



DENVER WATER

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I. Purpose of the Information Document

Denver Water has determined that a water supply project is needed in the Moffat Collection System to solve reliability, vulnerability, flexibility, and yield problems described in this document. This document provides information to the public and agencies about the need for the Moffat Collection System Project, alternatives being considered to address the problems, and the process Denver Water will undertake to determine the project that will address Denver Water's needs and that can reasonably be expected to be authorized by the appropriate regulatory agencies.

The alternatives identified by Denver Water would require a Clean Water Act 404 permit from the U.S. Army Corps of Engineers. The Corps has determined that an Environmental Impact Statement (EIS) must be prepared to comply with the National Environmental Policy Act (NEPA). The NEPA scoping process is an effort to inform and seek comments from the public, state and local agencies, Native American tribes and other federal agencies about the project.

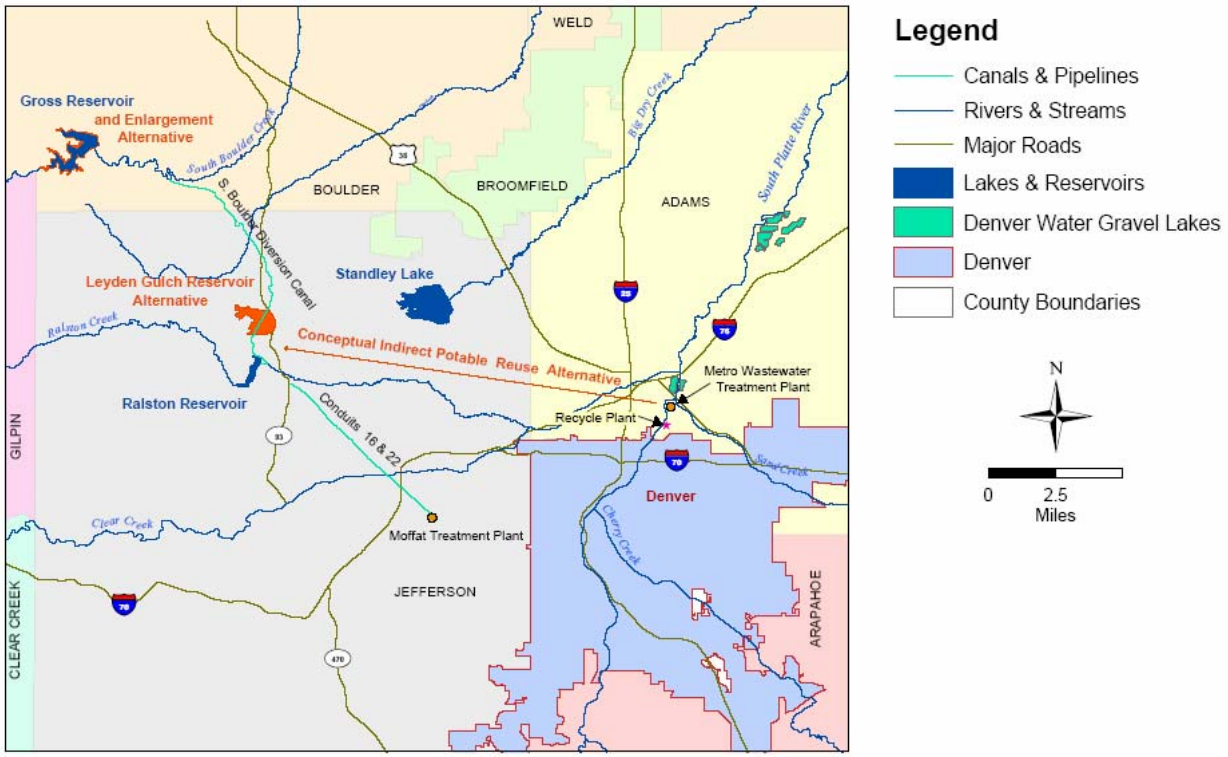
This Information Document provides background information concerning the problems and alternatives being considered by Denver Water. At this time, Denver Water has not selected a project. The following potential alternatives or combination of alternatives (Figure 1) are being considered:

- Enlarge Gross Reservoir (by 20,000 acre-feet or 70,000 acre-feet);
- Build a new off channel reservoir at Leyden Gulch (30,000 acre-feet or 60,000 acre-feet);
- Build an indirect potable water recycling project; or
- A combination of the projects described above.

Denver Water will use the information developed during parts of the Corp's NEPA process to select which project it will ask the Corps to permit. The tentative schedule for selecting Denver Water's preferred alternative and for completing the EIS is as follows:

Conduct NEPA Scoping	September – November 2003
Conduct studies to prepare the Draft EIS	September 2003 - November 2004
Denver Water's project selection	December 2004
Publish Draft EIS	February 2005
Public Hearings on Draft EIS	March 2005
Conduct additional studies (if needed)	April – September 2005
Prepare Final EIS	October 2005 – January 2006
Publish Final EIS	March 2006
Corps Record of Decision	June 2006 - October 2006
Begin construction of project	December 2006

Moffat Collection System Project Alternatives



II. Problem Statement

Denver Water is responsible for providing safe, high-quality, and dependable drinking water for over 1.2 million customers. To fulfill that responsibility, the Denver Board of Water Commissioners (Denver Water) developed an Integrated Resources Plan (IRP) in 1997 (updated in 2002) to analyze existing and future water supplies and customer demands, together with treated water infrastructure and conservation measures. The IRP and recent events have highlighted several existing system problems that could be eliminated or reduced significantly if new water supply can be located in Denver Water's Moffat Collection System (Figure 2). First, Denver Water has determined new supplies are needed as part of Denver Water's near term supply strategy. Second, the Moffat Collection System has an unreliable and inadequate water supply to meet present day demands of the Moffat Treatment Plant and raw water obligations that can only be served from the Moffat Collection System. Third, Denver Water's water collection system as a whole is vulnerable to manmade or natural disasters. Fourth, the treated water distribution and source water collection systems are susceptible to outages and failures, and therefore require a higher level of operational flexibility than is presently available. Denver Water is seeking a solution that will address the reliability, vulnerability, and flexibility problems in a way that produces 18,000 acre-feet of new firm yield. The solution must address all of the problems. Any solution that fails to resolve all four of the key issues fails as a resolution to Denver Water's needs.

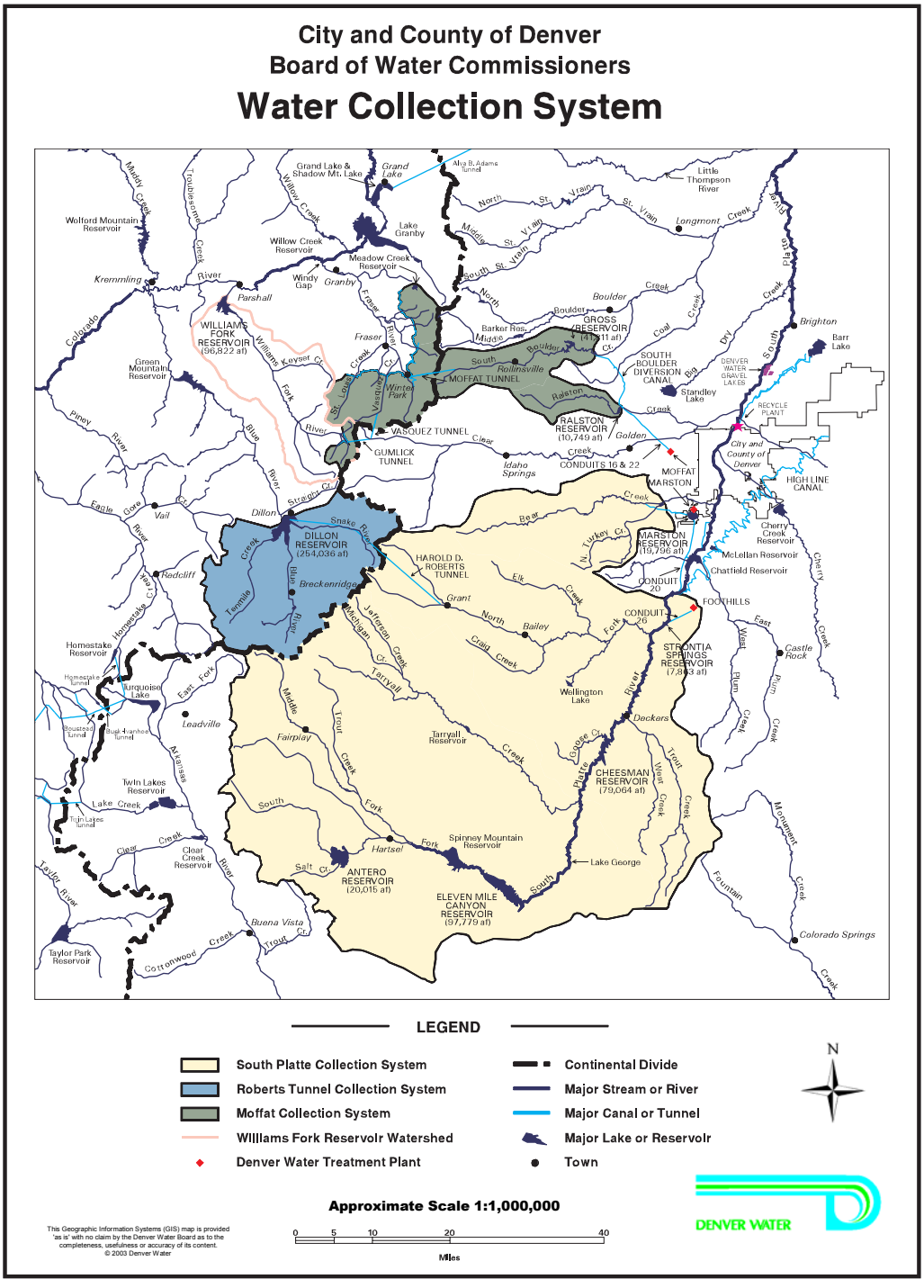
Need for Additional Water in the Moffat Collection System

The IRP has two timeframes: 1) the near term from 1996 to 2030, and 2) the long term from 2030 to the build-out of Denver Water's Combined Service Area (CSA). To meet Denver Water's IRP near-term strategy and contract commitments, 18,000 acre-feet of additional firm yield is needed. "Firm yield" refers to the average annual supply that can be delivered to customers over an extended period, including the 1953 – 1957 historic drought period. Approximately 72,000 acre-feet of reservoir storage would provide 18,000 acre-feet of firm yield. This 18,000 acre-feet is in addition to other IRP projects including the implementation of an aggressive conservation program, construction of a non-potable recycling project, and implementation of a number of refinements to the existing system.

The Reliability Problem – Inadequate Supply to the Moffat Treatment Plant

Denver Water's "South System" is made up of the South Platte and Roberts Tunnel collection systems, and the "North System" is made up of the Moffat Collection System. The South Collection System supplies water to the Foothills and Marston treatment plants, and the Moffat Collection System supplies water to the Moffat Treatment Plant. In contrast to the need for new firm yield, which relates to meeting future demands of

Figure 2


City and County of Denver
Board of Water Commissioners
Water Collection System
Grand Lake & Shadow Mt. Lake
Grand Lake
Alva B. Adams Tunnel
Little Thompson River
Wolford Mountain Reservoir
Willow Creek Reservoir
Lake Granby
Meadow Creek Reservoir
Windy Gap
Granby
Kremmling
Parshall
WILLIAMS FORK RESERVOIR (96,822 af)
Green Mountain Reservoir
Fraser
Winter Park
MOFFAT TUNNEL
Rollinsville
Boulder
Barker Res.
Middle St. Vrain
North St. Vrain
South St. Vrain
Longmont
Boulder Creek
GROSS RESERVOIR (41,811 af)
SOUTH BOULDER DIVERSION CANAL
Standley Lake
DENVER WATER GRAVEL LAKES
Brighton
Barr Lake
RECYCLE PLANT
RALSTON RESERVOIR (10,749 af)
Golden
City and County of Denver
HIGH LINE CANAL
VASQUEZ TUNNEL
GUMLICK TUNNEL
Idaho Springs
CONDUITS 16 & 22
MOFFAT
MARSTON
MARSTON RESERVOIR (19,796 af)
Cherry Creek Reservoir
McLellan Reservoir
Chatfield Reservoir
CONDUIT 20
CONDUIT 26
FOOTHILLS
STRONTIA SPRINGS RESERVOIR (7,843 af)
Castle Rock
DILLON RESERVOIR (254,036 af)
Breckenridge
HAROLD D. ROBERTS TUNNEL
Redcliff
Vail
Dillon
Wellington Lake
Deckers
Tarryall Reservoir
CHEESMAN RESERVOIR (79,064 af)
Spinney Mountain Reservoir
Lake George
ANTERO RESERVOIR (20,015 af)
ELEVEN MILE CANYON RESERVOIR (97,779 af)
Leadville
Twin Lakes Reservoir
Homestake Reservoir
Turquoise Lake
Taylor Park Reservoir
Colorado Springs
LEGEND
South Platte Collection System
Roberts Tunnel Collection System
Moffat Collection System
Williams Fork Reservoir Watershed
Denver Water Treatment Plant
Continental Divide
Major Stream or River
Major Canal or Tunnel
Major Lake or Reservoir
Town
N
Approximate Scale 1:1,000,000
0 5 10 20 40
Miles
This Geographic Information Systems (GIS) map is provided 'as is' with no claim by the Denver Water Board as to the completeness, usefulness or accuracy of its content.
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DENVER WATER

Denver Water's customers, the reliability problem is a present day problem specific to the Moffat Collection System and Treatment Plant.

During a severe drought, even a single severe dry year, Denver Water's raw water customers as well as the Moffat Treatment Plant can run out of water. If the Moffat Collection System runs short of water, Denver Water's ability to meet its customer demands is seriously compromised. The shortcomings of the Moffat Collection System water supply were clearly demonstrated during the drought of 2002. In April 2002, raw water system operators determined that the Moffat Collection System would run out of water by July if Denver Water made required deliveries to treated water and raw water customers from the Moffat Collection System. Many emergency measures were taken to reserve as much water supply as possible in Gross Reservoir in the event the drought continued into 2003 and beyond. One such measure was to shut down the Moffat Treatment Plant during much of the year to reserve storage in Gross Reservoir.

If the South System water supply had been compromised by any significant outage, Denver Water would not have been able to meet its customers' water demands. Simply stated, constant vigilance and a fair amount of luck were required to keep the South System running almost perfectly to meet even the drought-reduced customer demand. The emergency operations of 2003 do not provide a permanent solution to the reliability problem because they were wasteful, uneconomical and relied on a large measure of luck. Additional water supplies provided to the Moffat Treatment Plant and raw water customers would be needed to permanently address the reliability problem.

The Vulnerability Problem

Denver Water's collection system is unacceptably vulnerable to natural and manmade disasters and system failures that would cause loss of critical component that supplies South System water to customers. This is because 90 percent of available reservoir storage and 80 percent of available water supplies rely on the unimpeded operation of Denver's South System. Loss of a portion or all water supply from the South Collection System results in a need to provide more water from the Moffat Collection System than is available, resulting in a potential inability to meet customers' water needs. The critical components that supply south side water are:

- Collection system – Roberts Tunnel, Cheesman Reservoir, Strontia Springs Reservoir, Conduit 26 (which supplies Foothills Water Treatment Plant), Conduit 20 dam and pipeline which serves Marston Reservoir and Marston Treatment Plant.
- Foothills and Marston Treatment Plants.
- Transmission Lines – Conduit 27 and Conduit 20, the main arteries for transporting South System water supplies from Foothills and Marston Treatment Plants.

Examples of natural disasters that jeopardize South System water supply include forest fires, landslides, earthquakes, and floods. Manmade disasters include terrorism, and chemical spills. After the 1996 Buffalo Creek fire, a major rainstorm and subsequent runoff containing ash, sediment, and debris, seriously impaired the quality of water entering Strontia Springs Reservoir, restricting significantly the treatment rate at the Foothills and Marston treatment plants. These two treatment plants treat all of the water derived from the South System. If this natural disaster had occurred during a drought, or the fire and subsequent flooding had been more severe, or another mishap had occurred in the system, Denver Water's ability to meet its customers' water demands would have been jeopardized.

The terrorist attack of September 11, 2001, has forced all utilities to consider new kinds of vulnerabilities. Denver Water has just completed a vulnerability assessment required by federal legislation passed in 2002. Obviously, the ability to satisfy water demands from more than one source and enhanced operational flexibility are essential to reduce Denver Water's vulnerability to this type of event.

System failures include the failure of pipes and tunnels, reservoirs, treatment plants, pipelines, valve malfunctions, and electrical failure. An example of such a failure is the 1996 Roberts Tunnel valve and powerhouse flood caused by a burst in the domestic water supply line in the valve and powerhouse. Deliveries of water from the Roberts Tunnel were suspended for several weeks while the control equipment to operate the valves and generate power was replaced.

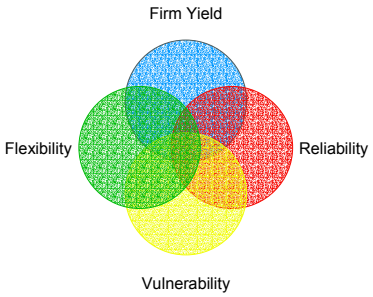
The Flexibility Problem

Both Denver Water's treated water transmission and distribution system and its source water collection system are subject to outages caused by routine maintenance, pipe failures, treatment process problems, power outages and a host of other predictable and unpredictable occurrences inherent in operating and maintaining a large municipal water supply system. For these reasons the system seldom operates at full capacity. Maintenance-required shutdowns or outages can reduce supply availability from the South Collection System, necessitating more use of Moffat Collection System supplies. A greater degree of operational flexibility is needed to keep these factors from impairing Denver Water's ability to satisfy its customers' water needs. However since the Moffat Collection System is supply short, Denver Water is constrained in its ability to load shift to the Moffat Treatment Plant under such circumstances. In short, even though Denver Water has three treatment plants and two main collection systems, there is insufficient water supply presently available from the Moffat Collection System to provide the needed range of operational flexibility to meet customer demands.

Problem Summary

The flexibility, vulnerability, and reliability problems all compromise Denver Water's ability to provide existing customers a safe, dependable water supply. By developing 18,000 acre-feet of firm yield needed for meeting future customer demands within the

Moffat Collection System, all four of these problems can be addressed. The diagram shown below illustrates this concept.



III. Background Information

A general policy of the IRP is that Denver Water will not expand its service area. Denver Water clearly defined a Combined Service Area (CSA) comprised of the City of Denver and 78 suburban contract distributors (Figure 3). Denver Water committed to serve the build-out needs of this area, and also to provide fixed amounts of water to certain entities outside of the CSA. This approach makes it manageable to estimate the water needs as growth within the CSA proceeds to build-out. Today, Denver Water provides water to over 1.2 million customers whose average annual water demands are 285,000 acre-feet.

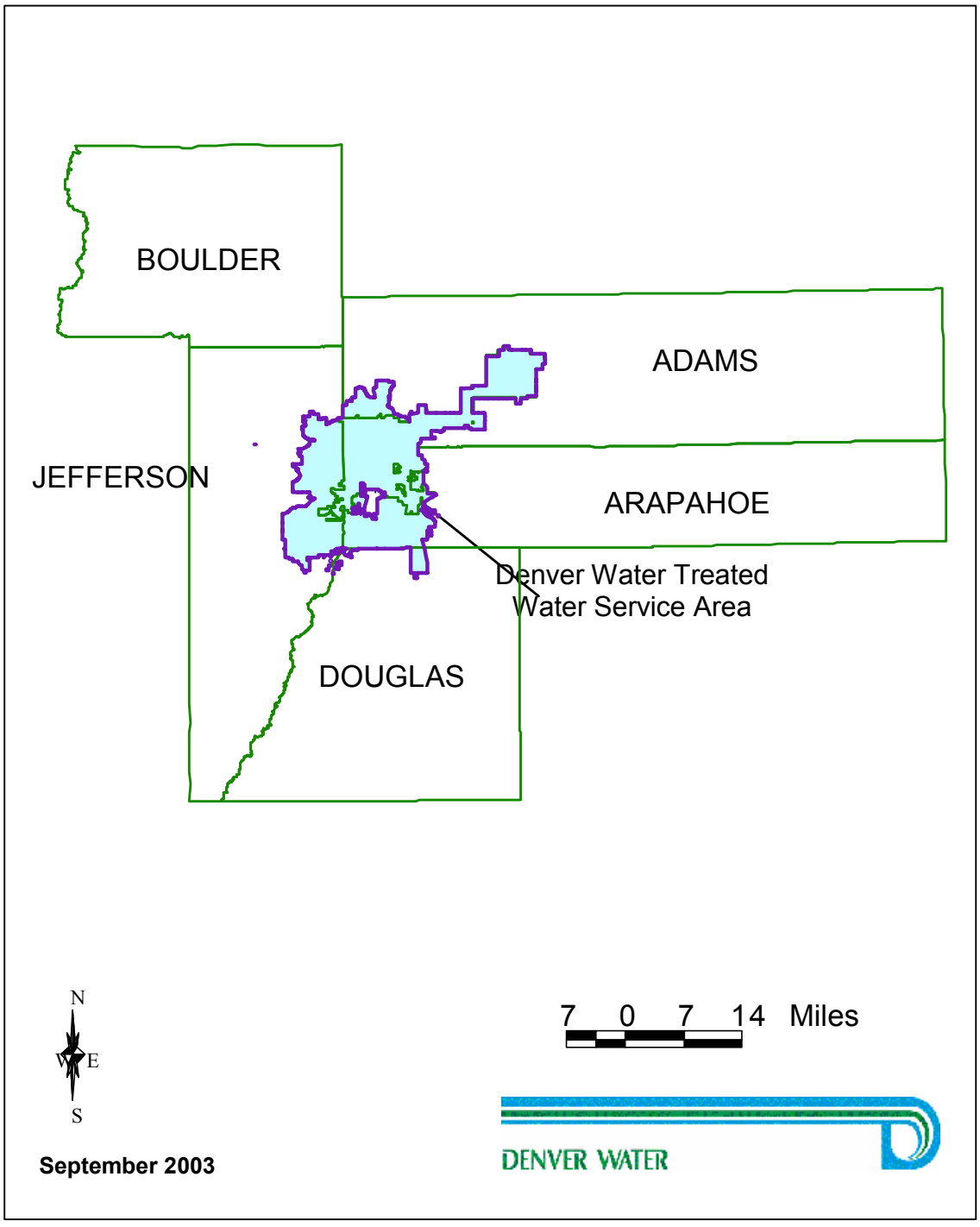
Water Collection System

The water collection system is defined as all diversion, collection and transmission facilities that store and distribute source water prior to treatment. There are three major systems: the South Platte Collection System, the Roberts Tunnel Collection System and the Moffat Tunnel Collection System. Locations of these facilities are shown in Figure 2. These three collection systems can be grouped into two distinct delivery systems:

- The South System, which is comprised of the Roberts Tunnel Collection System (including Dillon Reservoir) and the South Platte Collection System. These systems deliver water to Foothills and Marston treatment plants.
- The North System, which is comprised of the Moffat Tunnel Collection System that delivers water to the Moffat Treatment Plant.

The Roberts Tunnel Collection System includes Dillon Reservoir and Roberts Tunnel. These facilities capture and store water from tributaries in the Blue River Basin and subsequently deliver this water to the Eastern Slope for use in the Denver metropolitan area.

Figure 3
Denver Water Combined Service Area



The South Platte Collection System captures water from the mainstem of the South Platte River, as well as from Bear Creek and Cherry Creek, and subsequently delivers this water to the Denver metropolitan area. The major facilities in the system include Antero Reservoir, Eleven Mile Canyon Reservoir, Cheesman Reservoir, Strontia Springs Reservoir and Conduit No. 26, Platte Canyon Intake Dam and Conduit No. 20, Marston Reservoir, Platte Canyon Reservoir, Harriman Ditch and Conduit No. 15, and Cherry Creek wells. Denver Water also has storage in Chatfield Reservoir and either owns or holds an interest in a number of ditch companies and ditch systems that operate in the metropolitan area, such as the High Line Canal and the Farmers and Gardeners Ditch. In addition, Denver Water and South Adams County have jointly acquired gravel pit sites along the South Platte River in Adams County. The pits will be converted to storage facilities and used to exchange reusable water upstream to Denver Water's facilities.

The Moffat Tunnel Collection System captures water from the Williams Fork River, the Fraser River, South Boulder Creek and Ralston Creek, and subsequently delivers this water for use in the Denver area. The major facilities in the system include the Williams Fork Collection System, August P. Gumlick Tunnel (Jones Pass Tunnel), Vasquez Tunnel, the Fraser River Collection System, the Cabin-Meadow Creek Collection System, Moffat Tunnel, Gross Reservoir, South Boulder Diversion Canal, Ralston Reservoir, and Long Lakes. Denver Water also has a storage pool in Consolidated Mutual's Fortune Reservoir (Walter E. Welton Reservoir).

Williams Fork Reservoir is located on the Williams Fork River near its confluence with the Colorado River in Parshall, Colorado. Williams Fork Reservoir is used to exchange water to the Moffat Collection System and the Roberts Tunnel Collection System, and on occasion is used as a substitution source for Denver Water's obligation to Green Mountain Reservoir. Exchanges and substitutions are described below.

In addition to the above water collection systems, construction of the water recycling project near the Metro Wastewater Reclamation District plant is underway. Upon its completion, the recycling plant capacity will be 45 million gallons a day, delivering up to 20,000 acre-feet of water per year to non-potable uses. Customers include the Cherokee Power Plant, Washington Park, City Park and Golf Course, Denver Country Club, the Park Hill Golf Course, redevelopment at Stapleton and Lowry, the Rocky Mountain Arsenal, Denver International Airport, and various parks and industrial users along the distribution system route.

The existing infrastructure and water rights that make up Denver Water's Collection System are capable of providing 375,000 acre-feet of firm yield.

Operations

The primary goal of collection system operations is to capture the water necessary to provide a reliable, high-quality water supply to Denver Water's customers. Ultimate delivery of most of the collected water is to Denver's three water treatment plants—

Moffat, Marston and Foothills—but some is used for irrigation and industrial purposes, or is provided to local suppliers by contract. In addition to the primary goal, there are several other considerations, such as environmental enhancement and recreation, maximizing hydropower revenue, and minimizing treatment and distribution costs. In some instances, the collection system is used for flood reduction for local communities. All of these issues are important to effective operations.

To enhance the dependability of the collection system, reservoir storage must be managed to provide space to capture spring runoff so that no reservoir spills water while another fails to fill. To attain these conditions, the water supply from all sources must be forecast or estimated. Construction projects, maintenance activities, water quality considerations, contractual obligations and numerous other factors also restrict how the collection system is operated.

In most years, more water is available to the collection system during the runoff season than can be consumed or stored. However, during the winter months and in dry years, the available water from streams is less than the demand for water, so that water must be withdrawn from storage.

Reusable and Non-Reusable Water

All water delivered by Denver Water to its customers is classified as reusable or non-reusable. Whereas return flows of non-reusable water belong to downstream water rights and cannot be used a second time by Denver Water, return flows of reusable water can be used over and over again until that water is fully consumed. The main sources of reusable water in Denver Water's collection system are:

- The Blue River.
- Fraser River water diverted by the Meadow Creek system, the only reusable water associated with the Moffat Collection System.
- Transferred agricultural water rights.

Reusable water that is delivered by Denver Water is tracked until it returns to a stream as effluent from a wastewater treatment plant or by groundwater return flow as a result of lawn irrigation. The Metro Wastewater Reclamation District Plant and the Littleton-Englewood Wastewater Plant are the primary return flow points of Denver Water's reusable water. Denver Water currently reuses portions of these supplies through exchanges and transfers, which are described below. In the near future the recycling plant will rely on reusable effluent as its source of water. Reusable effluent would also be the primary water source for an indirect potable water project.

Exchanges, Transfers and Substitutions

In an exchange, reusable water is added to a stream at a downstream point to enable diversion of the same amount at an upstream location. In a transfer, water is released

from an upstream reservoir so it can be stored in a downstream reservoir or delivered to a water treatment plant. Exchanges increase the amount of water that can be legally diverted at an upstream location. Exchanges that would injure a water right between the replacement and diversion point cannot be performed. The major source of replacement water for Denver's exchanges is the reusable water returning to the South Platte as effluent from the Metro Reclamation District and the Littleton-Englewood wastewater treatment plants.

Exchanges and transfers give Denver Water the ability to move water from place to place within the collection system. For example, if operators want to store water in Dillon Reservoir when such storage is out-of-priority, they can perform a Williams Fork Reservoir-to-Dillon Reservoir water exchange. The exchange would be accomplished by releasing water out of Williams Fork Reservoir for use by downstream senior water rights and storing a like amount of water in Dillon Reservoir. An example of a transfer is the conveyance of water from Gross Reservoir to Ralston Reservoir to meet water needs at the Moffat Water Treatment Plant.

Some of the exchanges commonly performed within the collection system are listed below:

- Metro Wastewater Treatment Plant to Strontia Springs Reservoir.
- Bi-City Wastewater Treatment Plant to Strontia Springs Reservoir.
- Williams Fork Reservoir to Dillon Reservoir.
- Williams Fork Reservoir to Moffat Tunnel.
- Chatfield Reservoir to Cheesman Reservoir.
- Blue River water to Cheesman Reservoir.

Denver Water and South Adams County Water and Sanitation District have jointly acquired gravel pit sites along the South Platte River in Adams County. The pits will be converted to storage facilities and used to maximize exchange of reusable water upstream to Denver Water's facilities.

Another important operation that is similar to an exchange is a substitution, where water is released from one source in place of another supply. While exchanges are instantaneous, there is a time delay for substitutions. Releases from Williams Fork Reservoir can be made in substitution for releases from Green Mountain Reservoir, a Bureau of Reclamation reservoir. This operation allows Denver Water to fill Dillon Reservoir which is located upstream of Green Mountain Reservoir and has junior water rights to Green Mountain, using water that Green Mountain was entitled to store. This operation can be conducted because Green Mountain Reservoir will usually fill from the water supplies that enter the Blue River between Dillon and Green Mountain reservoirs. If Green Mountain Reservoir fails to fill, water supplies from the Williams Fork Reservoir are released (substituted) to downstream water demands in place of releases from Green Mountain Reservoir.

Treated Water System

Denver Water serves treated water to the City and County of Denver and 78 suburban distributors. Denver delivers treated water to 280,000 accounts and approximately 1.2 million persons. About 52 percent of the accounts are within the City of Denver.

Denver Water's treated water facilities include:

- The Foothills, Marston, and Moffat treatment plants, with capacities each of 280, 185, and 180 million gallons per day (mgd), respectively. The plants have a combined capacity of 645 mgd.
- 17 pump stations with a pumping capacity of 1,053 mgd.
- 30 treated water storage reservoirs in 16 locations totaling 344 million gallons.
- 2,474 miles of pipe; 39,500 valves; and 14,000 hydrants.

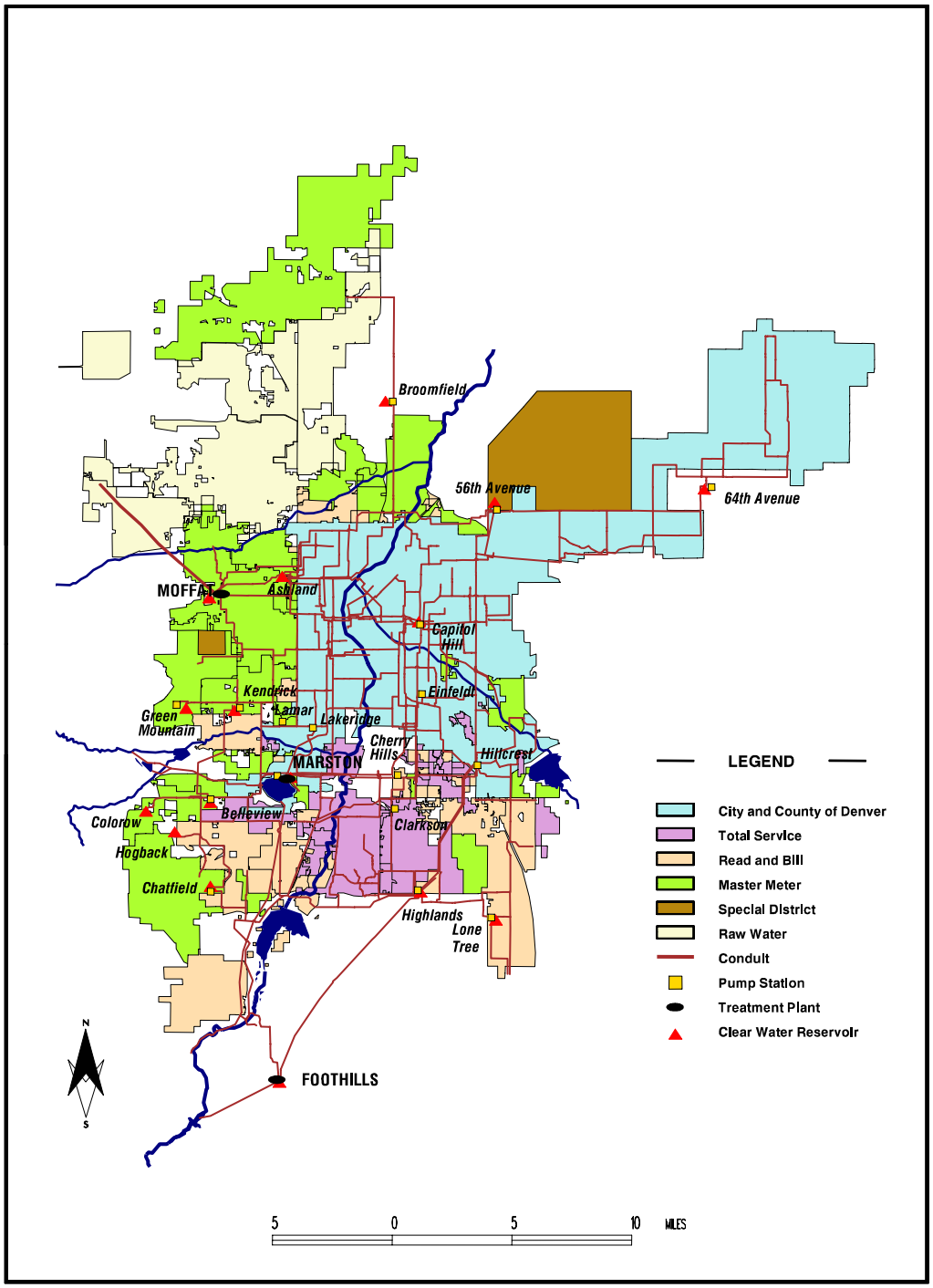
On average, Denver Water customers currently use about 220 mgd. Winter demand is about 120 mgd, while water consumption on a peak summer day may exceed 500 mgd.

The Foothills and Marston treatment plants treat water from the South Platte Collection System and Roberts Tunnel Collection System, while the Moffat Treatment Plant treats water from the Moffat Collection System. The system is integrated and connected such that water from any of the three treatment plants could provide service to most areas within the CSA during periods of low demand. In general, the Foothills Treatment Plant is "base loaded," or relied on as the first treatment plant used to meet treated water demands, because of its lower cost of operation and ability to provide for much of the areas Denver Water serves by gravity. The Marston Water Treatment Plant and Moffat Water Treatment Plant are used as peaking plants, with priority determined by supply considerations and cost of operation. From the treatment plants, main conduits deliver water either directly into the distribution system or to pump stations and clear water storage reservoirs. These pump stations and reservoirs deliver water to the distribution system, which is divided into about 160 pressure zones. The distribution system is generally configured so that water from the conduits is distributed into a grid of 12-inch pipe on about one-half-mile centers. The 12-inch grid, in turn, delivers water into the local 8-inch and 6-inch distribution pipe. The system is designed for dual feed to any area to minimize service interruption and to maintain fire protection capability. Figure 4 shows the major treated water distribution features.

Defining Future Demands in the Combined Service Area

The demand forecast from the CSA defines how much additional water Denver Water will need beyond its existing supplies and when that water will be needed. Forecasting water demand is primarily a function of two variables: future demographic growth (population, households, income) within the CSA and the rates of water usage for those demographics. Growth within the CSA is derived from regional demographic forecasts, along with estimates of where metro area growth will occur. The usage relationships emerge from detailed analysis of historical water usage patterns. Denver Water

Figure 4
Major Treated Water Distribution Features*



*Master Meter, Read & Bill, and Total Service refer to distributor contract types.

developed a model to forecast demand to the build-out of the CSA based on this analysis. The model results were then modified to reflect two additional factors: a reduction over time for "natural replacement" of plumbing fixtures and appliances with more efficient fixtures, and the addition of demands for fixed and special contracts in which Denver Water is obligated to provide water beyond the CSA boundary.

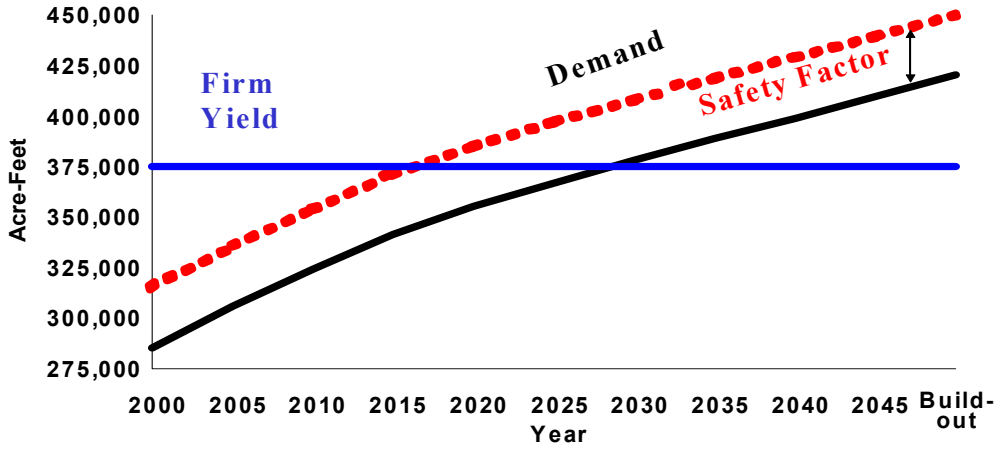
Denver Water based demographic growth forecasts within its CSA on the latest regional forecast (1999) from the Denver Regional Council of Governments (DRCOG). That forecast is prepared under the direction of DRCOG's Economic Task Force, a group of economic and demographic experts within the region. DRCOG independently prepares its demographic forecasts to meet its Metropolitan (transportation) Planning Organization and long-range regional development planning functions. This forecast extends to the year 2020.

Denver Water employed a consultant to extend DRCOG's 2020 forecast for the areas served by Denver Water to 2050. These extensions were consistent with DRCOG's 2020 forecasts. Currently, Denver Water serves approximately 1.2 million people and provides water under fixed and special contracts that support approximately 120,000 people beyond its CSA. When the population under fixed contracts is added to the CSA population in 2050, approximately 1.9 million people will be using Denver Water's water.

Figure 5 shows the relationship between existing supplies and future water demand projections. The Board maintains a 30,000 acre-foot safety factor, which, when added to the demand forecast, results in Denver Water's demand for planning purposes.

Figure 5

Denver Water Demand Forecast and Firm Yield



Conservation in Reducing Future Demands

It is important to note the role of conservation in reducing overall demands of Denver Water's CSA. Conservation of water has been an integral part of Denver Water's operations, and has reduced Denver Water's present day and build-out demands significantly.

Denver Water focused its conservation efforts in the late 1970s on intensive public education efforts that disseminated information to customers on how they could save water. This part of Denver Water's conservation program remains in place today to emphasize the importance of water conservation and to maintain conservation savings that resulted from the public education programs.

During the Two Forks Reservoir permitting process, Denver Water adopted various additional measures to promote conservation. The most significant of those measures was to meter all remaining unmetered customers (approximately 87,000 customers), and to institute new rate structures that would promote conservation by charging higher rates as customer use increased. These additional measures have had a very pronounced effect in lowering Denver Water's demand.

By 1996, when Denver Water completed its IRP, Denver Water had reduced overall system demand by approximately 30,000 acre-feet. As of 2000, future demand projections reflect this 30,000 acre-foot reduction. In the IRP Denver Water integrated these lower demand levels into its future resource planning, relying on a continuation of these demand reductions in the future. These demand reductions are the product of Denver Water's conservation programs since the 1980s, such as the gradual replacement of less efficient plumbing fixtures in homes with more efficient plumbing fixtures.

Denver Water's current conservation programs have evolved to more incentive-based measures that will promote future savings, building upon the progress of previous conservation gains. Those programs are outlined in the Technical Appendix on Conservation in the IRP update. These new conservation programs are aimed at producing 29,000 acre-feet of additional conservation savings over the next fifty years. About 16,000 acre-feet of this additional future conservation will be realized as part of the near-term IRP water resources strategy.

Denver Water has reduced its future demand projections by 40,000 acre-feet to account for natural replacement savings (gained through more efficient plumbing fixtures) that Denver Water expects to see in the CSA over the next fifty years. At 2050, Denver Water's demands will be approximately 100,000 acre- feet (or roughly 20 percent) below the demand that would have occurred without conservation and natural replacement. The demand line shown in Figure 5 incorporates all of the conservation savings described above except the 29,000 acre-feet of IRP conservation savings.

IV. IRP Future Water Supply Strategy

Through the IRP process, Denver Water adopted a near-term water supply strategy that includes an aggressive conservation program, a non-potable recycling project, system refinements, new supply development through cooperative projects and finally, new supplies developed by Denver Water. The inclusion of the first three components establishes the Board's commitment to maximizing the efficiency of its water supply system.

- Denver has committed to a conservation program intended to achieve 29,000 acre-feet of water savings by 2050. In the near-term planning horizon, 16,000 acre-feet of savings will be relied upon as a source to meet future demands.
- System refinements, including the development of gravel pit storage to optimize the amount of reusable effluent that can be captured and used, High Line Canal efficiency improvements, and the accounting for reusable lawn irrigation return flows are all projects to make existing supplies go further, and in a sense can be considered conservation efforts.
- The non-potable recycling plant will allow Denver Water to rely upon a significant portion of its reusable water supplies that otherwise would be lost to Denver Water as a water source.

Table 1
Near-Term Strategy (through 2030)

Component	Type	Acre-Feet (2001)
Conservation	Conserved	16,000
Non-Potable Recycling	Recycle	17,000
System Refinements	Supply	13,000
Cooperative Projects	Supply	10,000
New Supply Projects	Supply	15,000
Total		71,000

Through these aggressive measures to maximize the efficient use of existing water supplies, the need to develop new water supplies is reduced. Of the supplies identified in Table 1, non-potable recycling and system refinements will be on line within the next ten years and therefore have been included in the 375,000 acre-feet of firm yield shown in Figure 5. There is a need for an additional 25,000 acre-feet of new supplies, of which 15,000 acre-feet would be derived from the Moffat Collection System Project. As a result of a 1999 agreement with the City of Arvada, if Denver Water is able to increase the firm yield of the Moffat Collection System, Arvada is entitled to purchase up to 3,000 acre-feet of firm yield. Because this amount is above the 15,000 acre-feet of supply needed by Denver Water, the total firm yield that needs to be developed from the Moffat Collection System Project is 18,000 acre-feet.

V. Moffat Collection System Project Alternatives

The three alternatives described below, or a combination of these alternatives, are reasonable options to address the problems defined earlier given the water rights, property and facilities owned by Denver Water that could be used to provide new supply to the Moffat Treatment Plant. As stated previously, Denver Water has not selected a project and fully expects additional alternatives will be brought forth during NEPA Scoping that could also address the problems. The NEPA environmental analysis will provide a thorough, comprehensive disclosure of impacts associated with these three alternatives, and other reasonable alternatives that are identified during the NEPA process. The following discussion describes some of the potential environmental issues associated with the presently identified alternatives.

Gross Reservoir Enlargement

Located 35 miles northeast of Denver in the Rocky Mountain Front Range, Gross Reservoir is the work horse of Denver Water's Moffat Collection System. The 41,811 acre-foot reservoir was constructed in 1955. The predominant source of inflow to Gross Reservoir is water diverted from the Williams Fork and Fraser rivers in the Upper Colorado River basin, which is conveyed to South Boulder Creek through the Moffat Tunnel.

Gross Reservoir occupies U.S. Forest Service and Denver Water lands. The landscape surrounding the reservoir is characterized by primarily Ponderosa Pine/Douglas-fir forest and to a much lesser extent, mountain grasslands (Figure 6). The immediate vicinity of Gross Reservoir is undeveloped although there is dispersed residential development and several state, county, and city open space parks located nearby.

In March 2001, the Federal Energy Regulatory Commission (FERC) issued a new license (Project No. 2035-006) for Gross Reservoir authorizing the continued use of the reservoir for water supply purposes and construction and operation of a 5-megawatt hydropower facility. The license recognizes that power generation is ancillary to the primary operation and use of Gross Reservoir as a municipal water supply. License conditions include a recreation management plan for the reservoir, development and implementation of an erosion and sediment control plan for social trails and roads, implementation of a weed management plan, implementation of a dissolved oxygen monitoring plan, implementation of a ramping rate plan to control the allowable rate of flow changes to minimize impacts to the fisheries, and implementation of a power-line raptor protection plan and sensitive species surveys. The license is being amended to allow for an increase in capacity and relocation of the powerhouse.

Figure 6
Gross Reservoir

Gross Reservoir has two potential enlargement sizes: 20,000 acre-foot enlargement and 71,000 acre-foot enlargement (Figure 7). The 20,000 acre-foot enlargement would raise the existing dam by 30 feet for a total storage capacity of approximately 62,000 acre-feet and would allow for continued use of the existing hydropower plant. Water to fill the reservoir would come from increased diversions of Denver Water's water rights in the Fraser River and Williams Fork rivers and in South Boulder Creek, primarily during the spring runoff months of average and wet years. The 71,000 acre-foot enlargement would raise the existing dam by 125 feet. The enlarged reservoir would have a total storage capacity of approximately 113,000 acre-feet. To maximize hydropower generation, an additional hydroelectric unit could be constructed. This would require enlargement of the hydropower plant licensed by FERC. A 20,000 acre-foot enlargement could provide approximately 5,000 acre-feet of additional firm yield and a 71,000 acre-foot enlargement would provide approximately 17,000 acre-feet of firm yield.

Examples of potential environmental issues associated with the Gross Reservoir enlargement alternatives include:

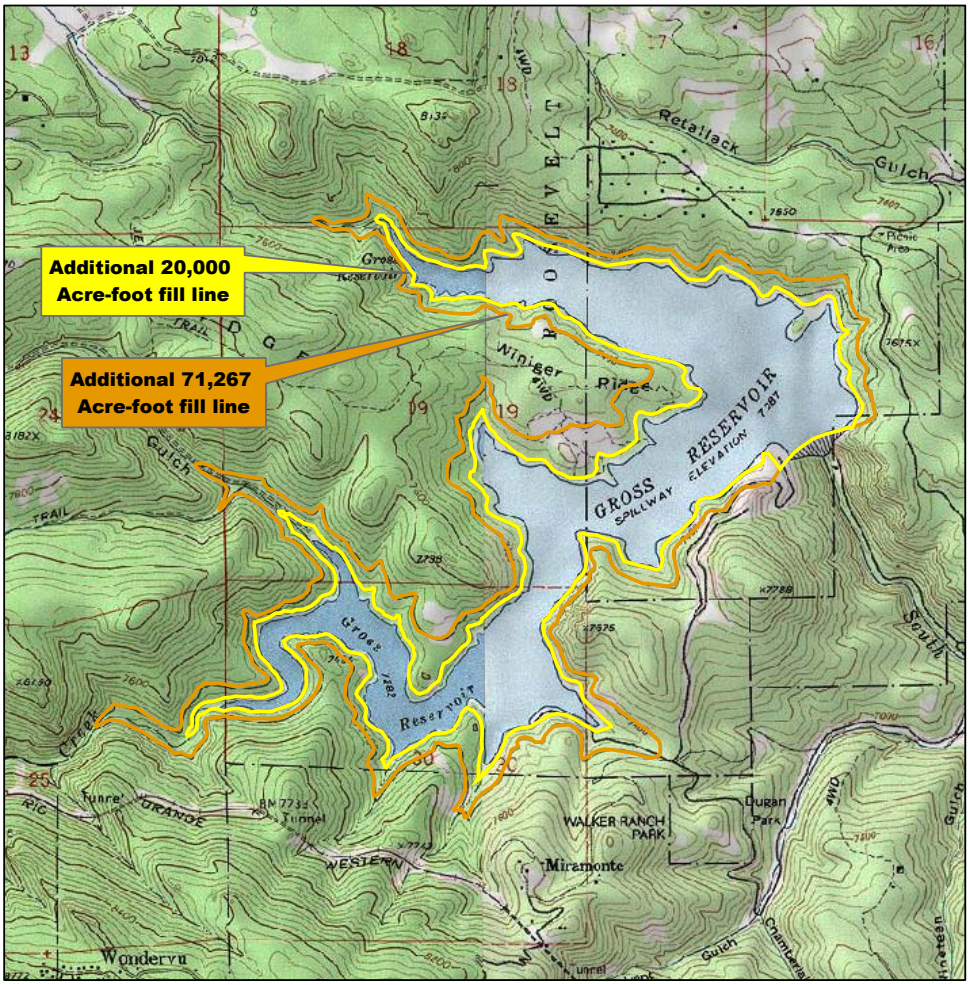
- On-site impacts associated with the construction of the dam and inundation area of the reservoir enlargement.
- Recreation at Gross Reservoir.
- Socioeconomic effects to the community immediately surrounding Gross Reservoir.
- Aquatic resources, including wetlands, fisheries, water quality and endangered species that may be affected by increased diversions from the Fraser and Williams Fork rivers.
- Aquatic resources, including wetlands, fisheries, water quality and endangered species that may be affected by increased flows in South Boulder Creek between Moffat Tunnel and Gross Reservoir, and changed flows below Gross Reservoir.
- Resources affected by changes in hydrology in other parts of Denver Water's Collection System from operation of a larger Gross Reservoir.

Leyden Gulch Reservoir Alternative

The Leyden Gulch Reservoir site is located in Jefferson County, about 5 miles north of Golden, Colorado, south of Highway 72 and immediately west of Highway 93 (Figure 8). The reservoir site is a valley bound by remnant alluvial fans to the north and south and the Laramie hogback formation to the west. The vegetative cover is predominantly short-grass prairie, with a narrow riparian corridor lacing its way down the valley. Leyden Gulch in this headwater area is ephemeral, and typically flows during spring runoff and during summer storm events. The reservoir site, which is primarily owned by Denver Water, is used for cattle grazing.

Figure 7

Gross Reservoir Enlargement Alternatives



0 0.5 1 2

Miles

Scale Approximately 1:24,000

DENVER WATER

Figure 8

Photo of Leyden Gulch Reservoir Site

Two reservoir capacities are being considered (Figure 9). The first, a 60,200 acre-foot reservoir capacity, is the maximum capacity that could be built at the site. It would have a dam height of 300 feet and require relocation of Highway 93 and realignment of the Denver & Rio Grande Railroad along the northern edge of the reservoir. The second, a 31,300 acre-foot reservoir, would have a dam height of 150 feet, but would not require relocation of the D&RGW Railroad or Highway 93. Leyden Gulch Reservoir could be filled through increased diversions of Denver Water's water rights in the Fraser and Williams Fork rivers and in South Boulder Creek primarily during the spring runoff months of wet and average years.

Examples of potential environmental issues associated with the Leyden Gulch alternatives include:

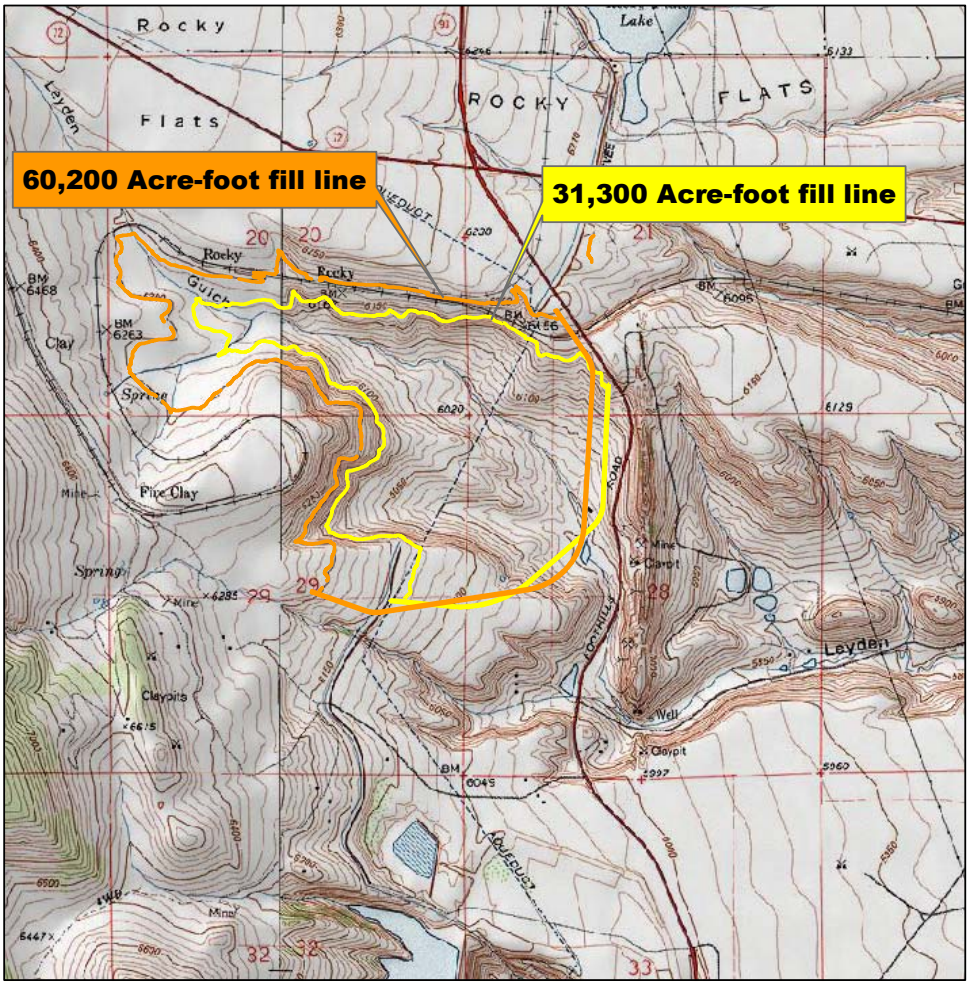
- On-site impacts associated with the construction of the dam and inundation area of the reservoir.
- Potential suitable habitat for the federally listed endangered Preble's meadow jumping mouse, and the federally listed Colorado butterfly plant and Ute-ladies' tresses. Surveys that have been conducted for all three of these species on the property have not indicated presence of the species.
- Aquatic resources in the Fraser and Williams Fork basins including wetlands, fisheries, water quality and endangered species that may be affected by increased diversions in the Fraser and Williams Fork rivers.
- Aquatic resources including wetlands, fisheries, water quality and endangered species resulting from increased flows in South Boulder Creek between Moffat Tunnel and Gross Reservoir, increased flows between Gross Reservoir and the South Boulder Diversion, and decreased flows downstream on South Boulder Creek below South Boulder Diversion.
- Resources affected by changes in hydrology in other parts of Denver Water's Collection System from operation of Leyden Reservoir.
- The potential relocation of the historic D&RG Railroad.
- The potential realignment of Highway 93.
- A black-tailed prairie dog community within the inundation zone.

Potable Recycling

An important source of water available to Denver Water is reusable effluent. This supply is available at the Bi-City, Glendale, and Metro wastewater treatment plants. Denver Water uses its reusable effluent through exchanges and through the non-potable recycling project. These uses capture most of the reusable effluent presently available during the summer months. However, on average there is approximately 15,000 acre-feet of reusable effluent remaining that could be used in a potable recycling project. This supply varies significantly from year to year and is primarily available during the winter months.

Figure 9

Leyden Gulch Reservoir Alternatives



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Miles

Scale Approximately 1:24,000

DENVER WATER

There are two identified methods for producing potable water from treated wastewater effluent: direct potable recycling and indirect potable recycling. In either method, water receives advanced treatment that includes several processes. Some of these processes remove the same types of contaminants and thus provide redundancies to ensure that contaminants are removed. This treatment method is known as the multiple barrier approach.

Indirect potable recycling water takes several steps. An advanced water treatment plant takes treated wastewater and further treats it to drinking water standards. This water is then blended with raw water. The blended water is then treated a second time using conventional treatment techniques. By contrast, direct potable recycling involves treating wastewater effluent to potable standards and then injecting the water directly into the potable distribution system to customers. All potable recycling projects currently in operation in the USA are indirect potable recycling. Current industry practice recommends an environmental buffer such as blending with raw water to address public health concerns. Therefore, Denver will be evaluating indirect potable recycling projects for consideration as a Moffat Collection System Project component.

Infrastructure for an indirect potable recycling project will include the following components:

- Construction of a new treatment plant.
- New storage for blending and retention time, or another method for blending water with a second source.
- Transmission lines from Metro Wastewater Treatment Plant to the advanced treatment plant, from the advanced treatment plant to the blending facility, and from the blending facility to Moffat Treatment Plant.

Potential configurations for the indirect potable recycling project could involve construction of a new treatment plant near Metro Wastewater Treatment Plant or near Ralston Reservoir. Potential blending facilities for an indirect potable plant could include Leyden Gulch, new gravel pit storage, or other storage locations. These configurations will be further defined as part of the EIS process.

Examples of potential issues associated with indirect potable recycling:

- On-site issues associated with the construction of the infrastructure (e.g., treatment plants, piping, storage facilities) and the effect on aquatic resources, endangered species and historic properties.
- Aquatic resources including wetlands and fisheries, water quality and endangered species in the South Platte River that may be affected by diversions of Denver Water's reusable effluent at the South Platte River near Metro Wastewater Treatment Plant.
- Resources affected by changes in hydrology in other parts of Denver Water's Collection System from operation of the indirect potable recycling project.
- Waste stream from the treatment plant.

VI. Next Steps

Denver Water intends to use the data and information developed through the Corps EIS process to select the project that will best address the four problems that have been identified. After studies are conducted, Denver will use the information to determine the project it intends to pursue. This project will become Denver Water's preferred alternative in the Draft EIS. Questions of Denver Water concerning its approach to identifying and permitting the Moffat Collection System Project can be addressed to:

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